ATOMS AND SPACE

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Introduction

The stated subject of this paper is so broad that it might include everything from the study of the infinitely small recesses of the atom to the vast infinity of galactic space. We will therefore begin by limiting the scope of the subject to a discussion of three questions: --- (1) What are the potentialities of the use of nuclear energy in the exploration of space? --- (2) What uses of nuclear energy in space exploration are expected in the next decade? --- (3) What is likely to be the impact of space exploration on the development of other applications of nuclear energy?

We will discuss these questions in relation to the space activities of the United States as set forth in the National Aeronautics and Space Act of 1958 and in the programs of the National Aeronautics and Space Administration, the agency established by Congress to carry out the policy established in that Act that activities in space should be devoted to peaceful purposes for the benefit of all mankind. Such activities include at present the exploration of space to gain greater knowledge and understanding of the earth and its atmosphere, the moon, planets, and the universe; the application of available knowledge to develop capabilities for other activities in space for the benefit of mankind; and the beginning of the exploration of space by man himself.

A program of this magnitude must be undergirded by a broad program of research and development in many fields of technology and by vigorous development of advanced technology at the frontiers of knowledge. The most visible aspects of the program are, however, the actual flight missions of space vehicles. In the current program these missions include those connected with scientific measurements in sounding rockets and earth satellites, lunar and interplanetary missions, meteorological satellites, passive communications satellites, and missions leading to manned satellite flight. As we look down the road we see more advanced missions, including hard and soft landings on the moon and planets, orbiting astronomical laboratories, circumlunar flights by man, landing of man on the moon and return, etc.

Mission Requirements

Whatever the mission, we find that propulsion systems are the key to possible accomplishment, whatever the specific objectives. We find now to our regret that we do not have propulsion systems required for the payloads for many of the missions we need to undertake. In fact we are unable to carry out many missions because we do not have the thrust required to carry available precise guidance systems in the final stage and hence can not perform those missions requiring precise guidance.

Our present capability has been further limited by the unavailability of upper stage rockets of the proper sizes to match the capabilities of the intercontinental missile boosters available for use as the first stage of a space vehicle. We have been compelled to use available rockets from the Vanguard satellite or other missile programs.

Energetic steps are being taken to develop as quickly as possible the required propulsion and vehicle capabilities, including optimized stages for the Atlas and Thor and new rocket engines with a thrust exceeding one million pounds. Although these early developments are based on chemical fuels, attention has been given to nuclear fuel. Before discussing the use of nuclear energy, it is well to review space mission requirements expressed in general terms.

From the standpoint of propulsion requirements any proposed space mission may be defined in terms of the velocity increment to be given to the final stage of the vehicle. Thus the mission of launching a probe from the earth to escape the earth's gravitational field as a one-way interplanetary probe requires a velocity increment from the velocity due to the earth's rotation to escape velocity, i.e. of about seven miles per second. If started from an earth orbit, the increment required is about two miles per second. An increment of about

100 miles per second is required to explore the entire solar system. In all missions the effects of gravitational forces and air resistance can be incorporated as an equivalent addition to the velocity finally acquired by the last stage to give the so-called "characteristic velocity" of the mission. The characteristic velocity for a single stage ground launched vehicle from Earth to Mars and return is about 25 miles per second.

Turning to a rocket propulsion system, the characteristic velocity added by a single stage depends primarily on the specific impulse of the propellant and the ratio of final weight to initial weight. The characteristic velocity is directly proportional to the specific impulse of the propellant. The weight ratio dependence is more complicated. In addition a change of propellant usually changes the weight ratio as well as the specific impulse especially if the engine type involves a change in the ratio of engine weight to gross weight. Hence accurate comparisons require preliminary design of vehicles incorporating each system.

Applications of Nuclear Energy

Since nuclear fission produces about ten million times as much energy per pound as the best chemical rocket propellants, there are obvious attractions in the use of nuclear fuel. Rocket propulsion, however, requires not only a source of energy but a means of utilizing the energy to overcome gravitational and air forces and accelerate the vehicle to a high speed. This requires a continuous supply of propellant to be ejected from the vehicle to give thrust.

Nuclear fission has been used to produce energy in the form of detonation of nuclear weapons and in the form of heat as in applications to the generation of power in ships and on land. In 1947 Ulam of the Los Alamos Laboratory proposed to produce thrust for a large space vehicle by using the thrust of a series of small nuclear explosions in rapid sequence, an idea that is undergoing further study at Los Alamos under support of the Atomic Energy Commission and at General Atomics under a contract from the Advanced Research Projects Agency of the Department of Defense.

The more conventional application of nuclear fission is to the nuclear rocket in which a reactor is used to add heat to a propellant which expands through a rocket nozzle to give the propulsive jet. Project Rover, a cooperative program between the AEC and NASA is intended to explore and demonstrate the feasibility of developing such a system.

In addition to applications of nuclear energy to the main propulsion system, there is much interest in nuclear energy as the source of auxiliary power in satellites and space probes. Communications equipment, auxiliary systems for attitude control, modification of orbits, and sensing devices for physical measurements present continuing needs for power for as long a life as practicable. Many of the systems use electrical power and hence energy conversion devices are essential parts of an auxiliary power system for satellites.

There is much speculation about the development of nuclear fusion as a source of energy for space applications, but until this method has been demonstrated for ground application, no serious work can be undertaken on space applications. It may be worth pointing out that for small power levels, solar power, which arises from nuclear fusion within the sun, is and will find useful application in satellites and space probes.

Nuclear Rockets

The potential performance of nuclear rockets has been reviewed in numerous recent publications, for example, "Potentialities and Problems of Nuclear Rocket Propulsion," by T. P. Cotter of the Los Alamos Laboratory in the February 1959 issue of Aero/Space Engineering, and four papers in the October 1959 issue of Astronautics by Frank E. Rom of NASA, Jerry Grey of Princeton, Franklin P. Durham of Los Alamos, and Robert W. Bussard of Los Alamos.

The specific impulse of any rocket, including the nuclear rocket, is approximately proportional to the square root of the ratio of the absolute temperature of the propellant before expansion to the bulk molecular weight of the propellant. Thus the propellant should have the lowest possible molecular weight, leading to hydrogen as the most desirable propellant. The temperature should be as high as possible and is usually determined by the materials used. This requirement leads to the necessity for engineering compromises.

Rom points out that potentially uranium fission can produce specific impulses of the order of hundreds of thousands (compared to about 400 for the best high energy chemical fuels) but at operating temperatures of hundreds of billions of degrees Fahrenheit. Obviously a compromise must be made.

In a solid-fuel-element reactor such as the Kiwi-A reactor recently tested in Project Rover, the temperature of the propellant is limited by the melting points of the solid materials containing the fissioning material. The most refractory materials, not yet usable in practice, are the carbides of hafnium and tantalum which melt at about 7000°F. Most engineers agree that 6000°F is about the maximum gas temperature ultimately attainable in solid-fuel-element reactors after much research and development. The corresponding specific impulse would be about 1200 - 1500.

Rom then discusses the possible use of liquid-fuel-elements with hydrogen bubbling through, giving, if development proved possible, a specific impulse of 1500 - 1800. A further step is to consider a gaseous reactor with cooled walls, but this concept is still in the earliest exploratory phase.

The best appraisal of the present status of the development of nuclear rockets probably comes from the engineers and scientists of Project Rover. Durham gives a specific impulse of 800 stated as the early design objective and outlines the design considerations of a turbulent-flow solid-core heat-exchanger reactor. Bussard concluded that the specific impulse should be in the range 2000 to 5000 for hydrogen for a useful payload capacity on most missions of interest within the solar system, that the specific power output should be aimed for 0.5 to 1.5 megawatts per pound, which would require gaseous reactors at temperatures between 20,000° and 60,000°R.

There is a fairly universal feeling that nuclear rockets are a necessity for the more difficult missions in which substantial payloads are given very large velocity increments. As previously pointed out, the gain in specific impulse is in part offset by the greater weight of the nuclear rocket and this effect may be predominant if shielding is required.

According to Cotter the experiments now in progress represent a first but important step toward the development of a system, which will not at first be spectacularly better than chemical systems but which has great potentiality for development well beyond that possible for chemical systems.

Auxiliary Power

Nuclear energy is attractive as a source of energy for auxiliary power for use in satellites and space probes. The heat source may be a reactor or the energy of decay of radioisotopes may be used. In each case it is necessary to provide a conversion system to generate electrical energy from the heat energy, since most of the equipment in a space vehicle requires the energy in that form. The Atomic Energy Commission's Project SNAP is aimed at the development of systems for nuclear auxiliary power. NASA intends to support the development of energy-conversion devices and to co-sponsor the development of systems required in the space program.

Radioisotope sources are capable of supplying power over the range of 10 to a few hundred watts with presently available conversion devices at weights of 1.0 to 0.6 pounds per watt according to a survey by Robert C. Hamilton of the Jet Propulsion Laboratory published in the August 1959 issue of Astronautics. Devices dependent on radioisotope decay have a power output which decreases with time. The decay is at a slower rate for isotopes of long half-life. The power unit radiates, and the nature of the radiation from the specific isotope determines the amount of shielding and the precautions to be taken during launching. Only a few radioisotopes meet the requirements.

Thermoelectric converters of three types have been proposed for use with radioisotope sources. In the first, sometimes called the vacuum diode system, the heat energy is used to heat a hot plate which emits electrons to be collected on a cold plate, thus generating an electric current. The spacing must be very small in order to avoid limitations imposed by space charge. By the use of cesium vapor to form a conducting plasma the spacing may be increased to form what is often termed a plasma diode or plasma thermocouple. Finally a thermoelectric semiconductor may be used. Heat is transferred by conduction to the hot junction of a thermocouple.

In January 1959 the President described a demonstration unit, SNAP 3, developed under the sponsorship of the Atomic Energy Commission. Because it was readily available, polonium 210 was used as the source of heat, the hot junction of the thermocouple being heated to about 700°F. The cold junction temperature was about 180°F. The output was 3 1/2 watts of 0.1 volt and the weight was about 5 pounds.

All of these devices for direct conversion of thermal to electrical energy, although in their infancy, are also of interest for use with nuclear reactors as the heat source. Substantial increases in power density, operating temperature, and life are to be expected with further development.

For powers of 1 to 30 kilowatts, Hamilton suggests that reactors using turbo-alternators for conversion may be obtained at weights of 500 to 200 lbs. per kilowatt for unshielded and 1000 to 350 lbs. per kilowatt for shielded systems. Light weight and long life while unattended are the conflicting requirements for acceptable systems. Such systems require the rejection of heat by radiation from a large radiator, whose weight is a major factor in determining overall system weight. The radiator area and hence weight is affected by the choice of gas or metal vapor cycle.

Electric Propulsion

If a nuclear electric power system is required to meet the requirement of large amounts of auxiliary power, there are great advantages in using the same source for an electric propulsion system. Such systems using ion accelerators, plasma accelerators, arc jets, or one of the many other systems using charged particles or ions as working fluid generate only a small thrust but the propellant consumption is very low so that operation may be continued over a long period of time. Electric propulsion is well suited for propulsion in interplanetary space and for control of the orientation and orbit of earth satellites. Thus a nuclear electric turbo-alternator system may provide both propulsion and auxiliary power with resultant economy for some missions. Such a system must however function unattended for long periods, one or more years, and under conditions of zero gravity. As in all space equipment there is a large premium on light weight.

Special Research and Development Problems

The use of nuclear energy in space exploration requires an extensive supporting research and development effort on many special problems. For example, the greater weight of a nuclear rocket as compared with chemical rockets offsets to some extent the higher specific impulse, and efforts must be made to reduce the system weight. A key element is the reactor which must be as small as consistent with the required performance. Requirements for small size and high power lead to a high power density. High temperatures (4000°F and preferably higher) and the desire for light weight results in high thermal stresses in the reactor fuel elements. The high temperature leads to the need for excess reactivity. The change in phase of the hydrogen propellant, involving a density change by a factor of 20, affects the dynamics of the system. Finally there are problems of corrosion, erosion, fuel bleedout, power distribution. Some of these problems are discussed by Durham in the previously cited reference.

The problem of radiation damage in the nuclear rocket is unique by virtue of the high leakage fluxes and the wide temperature range that exists in the nuclear rocket. Payload, guidance, and control systems requiring transistorized circuits probably must be shielded. A really new area is the low temperature, high flux exposure of the liquid hydrogen pump and liquid hydrogen tank. Because of the total lack of information, NASA is negotiating a contract with the Marietta Division of Lockheed to conduct a research program on the effects of radiation on the mechanical properties of materials operating at cryogenic temperatures. It is anticipated that the radiation effects may be severe under these conditions because there is no annealing at these temperatures.

Reference has been made to the need for large radiators in nuclear turboelectric systems. This gives rise to the need for much research and development in previously unexplored areas. Thus if the working fluid is a vapor which condenses in the radiator, problems arise in the separation of liquid and vapor in a gravity-free field. The same problem is encountered in the venting of hydrogen in the propellant tanks when subject to radiant heating from the sun. In order to radiate heat, the surface of the radiator must have a high emissivity. The emissivity may change with time during exposure to the space environment. The usual high-emissivity coatings may be unsuitable in the space environment. Meteoroids may erode the surface, changing its emissivity, or, if large enough, may puncture the radiator to cause leaks.

Finally, the presence of radioisotopes and nuclear reactors in satellites and space probes necessitates the study of operational requirements for their safe use.

Conclusion

To return to the questions posed in the introduction, by way of summarizing:

(1) The potentialities of the use of nuclear energy in the exploration of space are very great indeed both for primary propulsive power and auxiliary power. In fact there are certain tasks involving large payloads accelerated to high velocities for deep space missions that can not be accomplished by any other practicable means.

(2) Nuclear energy will probably first find space application in auxiliary power systems within the next decade. These same systems will find use in electrical propulsion at a later time, perhaps also within the next decade. A practicable nuclear rocket will probably be demonstrated toward the end of this period, possibly as an upper stage of an interplanetary probe, the reactor being started after escape velocity has been reached.

(3) The great advance in nuclear technology required for space application is bound to bring benefits to all nuclear technology, especially when and if the reliability needed for distant space missions of long duration is realized in practice.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

FOR RELEASE: NOV 4 1959
After Launch

SECOND LITTLE JOE BOOSTER LAUNCHED

The second in a series of Little Joe booster flights in the Project Mercury development program today was conducted from the National Aeronautics and Space Administration's Wallops Station.

The launching took place at 9:55 am EST to provide information on:

1. Performance of the escape system under maximum load conditions.
2. Design concepts of the capsule.
3. Further qualification of the Little Joe booster-capsule combination for several more flights.
4. Operation of the recovery parachutes.

The first Little Joe flight was held October 3 and was a proof test of the eight-engine launching vehicle system. The earlier flight used the entire booster package -- four larger Pollux engines and four Recruits. In today's launching, a short trajectory was desired and two of the Pollux engines were dummies.

The pilot escape system is a tower arrangement which sits on top of the capsule. In today's launch, it was subjected to maximum aerodynamic pressures which could occur in manned flight. The escape system is designed to separate the capsule and booster should a malfunction occur at any time during the early phases of flight. Triggered purposely in the launch today, the escape system will not be actuated in a normal launch.

Primary source of data on capsule behavior was [redacted] obtained by on-board recorders. Instruments inside the capsule telemetered to Wallops receivers information on accelerations [redacted] which occurred during the escape maneuver. Data also were received on aerodynamic motions and structural integrity during launch and on the escape and recovery phases.

CAPSULE FLIGHT

In today's flight, the capsule was boosted to an altitude of about 35,000 feet, and a distance of 5 miles. About 30 seconds after launch, the escape rocket was actuated and carried the capsule several thousand feet away from the booster. The escape rocket, which burned about a second, is located on the tower 16 feet above the capsule. After a 20-second coasting period, the escape tower was jettisoned. Ten seconds later, the drogue parachute was deployed to provide initial stability to the capsule and prevent it from tumbling end-over-end.

About three minutes after launch, at an altitude of about 10,000 feet, the main parachute deployed and eased the one-ton capsule into the Atlantic. The landing impact, at a velocity of 30 feet per second, is similar to the effect of a man jumping from a 14-foot wall.

Radar, camera and telemetry tracking were conducted from Wallops.

RECOVERY

Simultaneous with deployment of the main parachute, a smoke bomb ignited and a flashing light was energized.

Capsule recovery was completed 45 min after launch.

Search activities were conducted by two helicopters from Marine Air Group 26, located at the Marine Corps Air Facility, New River, N. C. Recovery was accomplished by the Navy salvage ship PRESERVER, assisted by a small Navy air-sea rescue vessel. Two chartered fishing launches from Chincoteague, Virginia, recovered the escape tower and parachutes.

In subsequent tests, search and recovery will be conducted by the Atlantic Fleet and other elements of the Department of Defense.

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59-241

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

NASA RELEASE NO. 59-247
Du. 2-7611

FOR RELEASE:
Thursday, PM's
November 5, 1959

SEPTEMBER CONTRACTS LISTED

The National Aeronautics and Space Administration obligated money for the following projects during September:

University of Michigan -- $90,000 -- Basic research on the plumbing erosion that occurs under high temperatures in certain rocket engines.

Geophysical Corp. of America -- $110,000 -- Instrumentation to measure electron density in the ionosphere.

Pratt & Whitney Division, United Aircraft Corp. -- $100,000-- Investigate heat transfer potentialities of a number of materials in a near-vacuum under extremely high temperatures that would be encountered in a nuclear-electric generating system.

Society of Photographic Scientists and Engineers -- $50,000-- Operational expenses for volunteer photo and radio tracking of earth satellites.

Thiokol Chemical Corp. -- $50,000 -- Spherical rocket motors for re-entry research.

Avion Division, ACF Industries Inc. -- $50,000 -- Radar tracking beacons for Scout.

Minneapolis-Honeywell Regulator Co. -- $140,000 -- Fabrication of a guidance and control system for Scout.

Republic Aviation Corp. -- $73,000 -- Study of lunar and interplanetary space probe trajectories.

Bendix Radio Division, Bendix Aviation Corp. -- $2 million -- Operation of minitrack stations for 1960.

Instituto Geofisico de Hyancayo -- $110,000 -- Operation of tracking and receiving station at Lima, Peru.

END

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

NASA RELEASE 59-250
EX. 3-3260
Ext. 6325

For Immediate Release
NOV 17 1959

EXPERIMENTAL SODIUM CLOUD LAUNCHED AT WALLOPS

As a part of International Rocket Week, the National Aeronautics and Space Administration today launched a sounding rocket into the upper atmosphere from Wallops Station to obtain geophysical information on upper wind activity.

The two-stage Nike-Asp launching vehicle lifted a payload which ejected a trail of sodium vapor beginning at an altitude of 50 miles. The trail extended to a peak of 150 miles where it appeared as a cloud as it was dissipated by winds. In the evening twilight, it was visible over a wide section of the Atlantic coastline.

Experiment objectives are to study wind velocities and directions and to measure the diffusion, or rate of spreading, at high altitudes.

Today's launching was the first of three to be held this week, and was essentially the same as one conducted from Wallops August 17. (See NASA Release 59-200 of August 17, 1959.) Clear weather is a critical factor in launching the sodium experiments because data are obtained from optical tracking at these widespread locations:

Marine Corps Base, Cherry Point, North Carolina; Camp A. P. Hill, Bowling Green, Virginia; Andrews Air Force Base, Maryland; Dover Air Force Base, Delaware, and Wallops Station, Virginia.

Depending on visibility, scientists will attempt to conduct the second launching tomorrow morning and the third tomorrow evening. NASA emphasized that these times are subject to change.

Three launchings will permit scientists to compare both morning and evening variations.

The 27-foot launching vehicle, with a gross takeoff weight of 1,550 pounds, has as its first stage the Army Nike and as the second stage the Cooper Development Corporation Asp. The payload, weighing 75 pounds, contained four pounds of sodium pellets. A timer ignited a thermite mixture to vaporize the sodium and exhaust it into the atmosphere from the ignition point to the rocket's peak altitude.

Working under NASA contract, Geophysics Corporation of America, located in Boston, packaged the payload, conducting tracking and will reduce data. Maurice Dubin of NASA Headquarters is experiment project chief. The Geophysics team is headed by Dr. Edward R. Manring and John F. Bedinger.

A NASA firing crew, headed by ~~John C. Palmer~~ Robert A. Duffy, launched the vehicle.

Today's experiment was one of a number planned by various agencies as a part of the U. S. contribution to International Rocket Week sponsored by the international Committee on Space Research (COSPAR). International Rocket Week is part of the program for International Geophysical Cooperation-1959, which is the continuation of the International Geophysical Year - 1957, 58. The IGY, IGC-59, and International Rocket Week are sponsored in this country by the National Academy of Sciences. Information gained from the rocket week launchings will be made available to the world scientific community.

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(Note to Editors: Photography of the trail and cloud is possible with a lens opening of f2.8, an exposure time of five seconds and tri-X film.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

NASA RELEASE NO. 59-251
EX, 3-3260
Ext. 6325

For Release
2 p.m. Nov. 18, 1959
(Released simultaneously by NASA and DOD)

SATURN AGREEMENT

Here is the text of a memorandum of understanding between the Department of Defense and the National Aeronautics and Space Administration on the interim management of Project Saturn pending its formal transfer to NASA. The agreement has been signed by Richard E. Horner, NASA Associate Administrator, and Dr. Herbert F. York, DOD director of Defense Research and Engineering. The text follows:

1. This agreement provides for the interim conduct of the SATURN project as described under ARPA Orders 14 and 47 and amendments thereto. It is effective immediately and until such time as responsibility is transferred to NASA in accordance with the 21 October 1959 memorandum approved by the President and in accordance with applicable law.

2. Technical direction of the project will be the responsibility of the Administrator, NASA, acting with the advice and assistance of a "SATURN Committee" composed of representatives from the NASA, ARPA, ABMA and Air Force under the chairmanship of the NASA.

3. The FY 60 funding of the project shall be continued at current levels unless revised by agreement between the Department of Defense and NASA.

4. Administration of the project shall be performed by the Director, ARPA, in accordance with the technical direction as prescribed in paragraph 2.

5. The project shall continue to be conducted through existing ARPA task orders with the Army Ballistic Missile Agency.

6. The Director, Defense Research and Engineering, will provide a statement of military interest to the Administrator, NASA, for guidance in the technical direction of the project.

7. It is the intention of NASA and DOD that this memorandum of understanding will be superseded at the time of the formal transfer of the SATURN Project to NASA from DOD.

8. Release of public information, and related public affairs arrangements, will be made by NASA or jointly by NASA and OASD(PA) pursuant to procedures to be developed by the Administrator, NASA, and ASD(PA).

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

ADDRESS TO THE NATIONAL PRESS CLUB

by
DR. T. KEITH GLENNAN
Administrator,
National Aeronautics and Space Administration

National Press Club
Washington, D. C.

19 November 1959

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DR. GLENNAN: Mr. President, distinguished guests, members of the National Press Club:

I am not at all certain that you haven't given my speech. These are days of discussions with the Budget Bureau. They are days of discussions in lots of places of the position which we as a nation now hold with respect to the Russians, and the position which we as a nation ought to be holding at some point in the future with respect to the Russians.

It is only a couple of weeks ago that a distinguished member of your profession, a gentleman who keeps a weather eye on the activities of our Agency, suggested that perhaps I would be better advised if I spent more time working at my job and less time talking about it.

The suggestion, which is many I get these days on a variety of subjects, causes me to recall the question that Walt Bonney tells me the British Prime Minister, the Honorable Harold Macmillan, once asked of himself from this very rostrum: "What the hell am I doing here, anyway?"

I hope that some 45 minutes from now I may have the same happy answer he provided to that question when he said, "I don't know, but I really enjoyed it."

Actually, in all seriousness, there are two basic reasons why I am here this noon. First, I was invited to make good on a promise that I had given nearly a year ago when NASA was only a couple of months old. I said then that I would be glad and proud for a chance to meet with you, but not until we had gotten underway and knew a little bit about the problems that were facing us.

Second, because even at the cost of getting away from my chores a very little bit, I think it is really important to tell the people of the United States, through you, some of the facts of life about our national space program, as I see it today, and as I go on in this discussion I think you will see what I mean.

I intend then to talk a little bit about where we stand today, and I will review briefly what we in NASA are doing, and then of course I will try to answer the questions which you put to me. I have, flanking me on either side, people who may be more able to answer some of them than I, and I am told that it is proper to throw them. They may not answer them.

By way of a starter, I would like to return to Mr. Macmillan's question, but in a more personal context perhaps. In order to come to Washington last fall I had to take leave from my duties at Case Institute of Technology, where I had had the great satisfaction of participating in the revolution that today is sweeping our system of collegiate education. Why did I exchange the pleasantly rewarding life on that Cleveland campus for my present assignment in NASA? The answer is quite simple. I had just made one of those fifteen-day Russian tours with a group of university presidents, eight of us in all, and thus I had become an overnight expert on the Soviet system of higher education.

Scanty as was the detailed knowledge which we obtained, one fact did stand out: The Russians are totally engaged in a drive to employ the educational process to win world leadership in technology, and thus to win world leadership in all other matters. Theirs is the fervor of the Crusades. As John Turkevitch, a great chemist and a great teacher at Princeton has said, "The Russian today has greater faith in the Soviet destiny through science than through Marxism."

We were hardly back in Washington when I was asked if I would come to Washington. It was for me a case of "put up or shut up."

Respecting my decision, I would like to make two other very personal, and I think pertinent, observations: First, in accepting the challenge I did so with a firm determination to do my utmost to accomplish a job that seemed very much to need doing; second, I never envisioned my assignment as one where I would always be driving the second place entry in this race that Bill talks about. I didn't see things that way last year and I don't see things that way today. But, as you may have observed, since then I have been eating a lot of Russian dust and I am afraid I will have to eat some more in the days that are immediately ahead.

A very great deal has been said about why we in the United States are where we are today in this space exploration business, vis-a-vis the Soviets. You have heard many times the same explanations. They are still valid. The Soviet missile and space scientists and engineers started serious work several days before we even decided to get seriously interested.

Their need for very large rockets to carry the then very large and very heavy atomic bombs determined, we think, the size of the rockets they still employ, both in their missile and space programs. When we were building those same heavy bombs ourselves, our heavy vehicle was the long-range jet bomber. It was only after our very substantial success in the design of nuclear weapons, both fission and fusion, had made possible high yield and relatively small and light weight packages, that we embarked on a rocket missile program with urgency.

At that juncture of course we needed less thrust to propel the lighter warhead, and thus the present Jupiter and Atlas rockets were designed to have from 150,000 to 365,000 pounds of thrust, compared with the Soviet booster estimated at some six hundred to seven hundred thousand pounds of thrust.

But that is not the whole story. With all the wisdom that 20/20 hindsight provides, we can see today that the Russians, a good many years ago, recognized something that escaped most of us: the probability that in the potentials of space exploration there lay a custom-made opportunity whereby they could prove to themselves and to the rest of the world that they excelled in a specifically, admittedly difficult area of scientific and technological effort.

They had, of course, the special advantage of being able to make their big try in privacy. If they failed, they could write off the costs in money and manpower, lives, and search for some other way to prove to themselves and to others that theirs is the superior society, that they could do anything they set their minds to do.

They have succeeded spectacularly in this undertaking. They have exploited to the fullest the psychological, the political and the propaganda possibilities accruing from the well-advertised, somewhat after the fact, accomplishments of their Sputniks and their Luniks.

In the United States our reactions have been violent, frequent, but of very short duration. In between the Russian Sputnik and Lunik firings we have been preoccupied with the progress of the World Series, with the standings in the pro football league, or the shabby disclosures of the TV quiz show investigations.

Each time the Russians have launched a new space explorer, we have reacted with a tremendous clamor to do something, right now, to catch up. And almost as promptly, once we had made our outcry, we turned to personal matters of greater interest to each one of us as individuals. The solution most often heard -- and it has been repeated many times -- is to appropriate more money, billions and billions.

Here in America we have come to the idea that more money can, all by itself, solve all of our problems, domestic and international. Certainly we are going to have to spend more money, and very large sums of money, if we are going to reach our goals in this space business. I shall have a little more to say about that later. First I should like to talk about some of the other things we need to do as a nation.

We plainly must awake to the fact that the Russians would very much prefer to gain mastery of the world without having to fire a single ICBM; that they hope to become so superior in their scientific, technological and economic capabilities that they will win world domination through industrial power, rather than through shooting wars.

Not only must we recognize this, but we must recognize also the many signs that now show they are doing the very things necessary to enter upon this economic domination. In many ways we in America have very much of which to be proud. I don't need to quote the statistics about our enormous productive capacity, about the number of Nobel prizes in science and medicine awarded to Americans in the last fifteen years as compared to the number awarded to citizens of the Soviet Union, or about the advances being made in this country in research and agriculture, in medicine, and in many other areas where the benefits ultimately must go to all of mankind.

Of course, we can point out that these advances have been accompanied by an ever-widening distribution of the comforts and the gadgets of modern living in these United States but having said that I have to come back to the fact that Russia is determined not only to catch up to us in the United States but to surpass us, all across the board. And they, too, as individuals, are gaining, however slowly, some of the better things of life -- consumer goods, as we call them.

For the past fifteen months my chief concerns have been problems affecting NASA and the national space program, but it has been impossible for me, because of my continued interest in education, to be unaware of the danger signals that are flying in the academic world.

Today Soviet Russia is training approximately two scientists and three engineers to every one of ours in these fields. The enrollment last year in the freshman classes of our engineering schools was down about eight thousand from the year before. Across the ocean the Russians graduated 94,000 engineers in 1958, 106,000 in 1959. There the curve continues to climb.

In Russia, perhaps because of the special rewards available to the possessors of high technical competence, the competition is very great among their youth for the chance to undertake the grinding, arduous schooling that all modern-day engineering training requires.

You realize, I am sure, that a degree in engineering today is a lot tougher to come by than it was some twenty years ago. The engineer must be knowledgeable about numerous scientific disciplines, in quite considerable depth, that were almost wholly unknown before the war in any of the engineering curicula. As a matter of fact, my own institution, Case Institute, and several others of the leading engineering colleges of the nation, are deeply involved today in efforts to develop new and better approaches to the training of scientists and engineers, a more rigorous training, which must include in many instances several years of graduate work for increasingly large percentages of the students.

Much of this development effort is being supported generously by the Ford Foundation, which announced only a couple of weeks ago initial grants of more than $22 million dollars to ten colleges and universities actively involved in these attempts to improve the quality of engineering education.

I cite these activities as an indication that our colleges are aware of the gravity of the situation and are doing something about improving the quality of instruction in science and engineering. This activity will be less than fully effective unless similar determined attention is given to educational programs of the elementary and secondary schools across the nation.

We have them in college for only four years as a normal thing, and you can not correct the lack of really rigorous training in the secondary schools in any period such as that. Initial efforts throughout the nation are encouraging in this regard, the improvement of the secondary school educational patterns, but there continues to be disturbing evidence that we are unwilling, as a people, to make the necessary investment to support the system.

The following from the Air Force Magazine may be an account of a situation that is extreme, perhaps, but I fear it is really symtomatic, and I quote from this article:

> "It may be fortunate that Arcadia, a suburb of Los Angeles, was not on Mr. Khrushchev's itinerary when he visited the West Coast. In Arcadia attendants are being used for classrooms because the high school can hold only 2200 of its 2700 students. The Superintendent of Schools says this situation was forced on him because the voters of Arcadia have rejected two proposed bond issues.
>
> "Mr. Khrushchev could have contrasted this situation with the existence, also in Arcadia, of the Santa Anita Race Track. There is no evidence of difficulty in financing the track, and at least some of the people at the Parimutual windows, it seems reasonable, voted against these school bond building issues.
>
> "We are sure," the article continues,"our provocative Russian friend would have used this to illustrate what he meant when he said, 'We will bury you.' He didn't mean in the wreckage of an atom-clobbered race track; he meant in the wreckage of our educational system."

Now I am not ready to admit that our educational system has been wrecked. The facts don't warrant so extreme a statement as yet. But the warnings are plainly evident; the facts are such as to require us to take at once the necessary actions that will permit our youngsters to obtain the kind of education and the kind of work habits and interest that will enable them to cope with the grim problems and the bright challenges of the four decades remaining in the Twentieth Century.

At the same time, by example and by precept, we must encourage our youngsters to be willing to make the large investment of hard work that earning such an education does require.

In this, as in just about every other aspect of our national life, we have got to quit "letting George do it," or Uncle do it.

Most of you, I am sure, have read Allen Drury's "Advice and Consent." Sometimes I wondered if he was writing about the future or about the present. For instance, when one of his characters pondered the unhappy facts of life and he said he had seen America rise, some sort of golden legend to our own people, some sort of impossible fantasy to others, and then in a sudden burst of Soviet science in the later '50s the golden legend crumbled. Overnight the fall began, the heart went out of it. A too complacent and uncaring people awoke to find themselves naked with the winds of the world howling around their ears. The impossible merry-go-round slowed down. Now the reaction was on in a time of worry and confusion and uncertainty. Men walked the tightrope between brittle confidence and sudden fear. He could not say exactly where the blame was to be placed except he knew that it lies on all of us. It attached to the fatuous, empty-headed liberals, to the embittered conservatives, on the military, on the scientist, and on the press and on politicians; not least upon the ordinary citizen and his wife who somehow didn't give quite enough of a damn about their country in spite of all their self-congratulatory airs about how patriotic they were.

Gentlemen, we know, I think, we can take comfort and hope from the knowledge that a great many of our citizens somehow did give quite enough of a damn about their country, but at least so far as space matters are concerned, there is need for greater singleness of purpose, for more sustained determination, for more light and less heat.

Within recent weeks I have received all sorts of conflicting reports about what the people of America want and are willing to do personally about U.S. space exploration. One member of Congress told me, following a six-weeks stay in his home state, "I talked to thousands of home folks; they were worried about the steel strike, about inflation, about farm problems, and so on. There was a good deal of hot indignation about the TV scandals. But to tell you the truth, not a single soul asked me about the space business."

Another Congressman told me that everywhere he went among his constituents the talk was about space and why weren't we doing more.

I am sure many of you have taken note of the poll run by the Los Angeles Mirror-News a few weeks ago, in which some two thousand readers took the trouble to fill out the answers to the questionnaire in the newspaper. The results indicated a deep concern over our comparative position with the Soviets in this field. As an interesting and perhaps significant comentary, some 56.6 percent said that they would be willing to pay more than $50 in new taxes next year if they could be assured that those taxes would be applied to the space business.

That kind of response is certainly encouraging. A group of citizens want us to do more in space, and they seem to be willing to pay some of the added costs for this.

Incidentally, I have had one check for $100 during my year in Washington, from a citizen who said, "Please apply this to support the space effort."

And yet another report tells me about the sad experience of the Franklin Institute in Philadelphia.

Last year they brought in top experts from all over the country to give a series of space lectures, and over 300 persons paid the necessary fees to learn more about space. The response in fact was so enthusiastic that a second series was scheduled for this fall and winter. At the first two lectures the attendance averaged only 30 persons, and the series was cancelled.

Why the confusion in this situation? Why the blow hot and the blow cold? Perhaps you gentlemen in this room can give me the answer.

Let me turn to a brief review of the activities we have undertaken since October 1 a year ago, when NASA became a functioning agency responsible for the national civilian space effort.

We had first to organize. We had to pull together the scientists and the engineers and the supporting personnel needed to do the tasks ahead. Fortunately for the most part it was possible to do this rather quickly, in the form of the staff, the research centers and the going programs of the National Advisory Committee for Aeronautics, the Vanguard team, the Jet Propulsion Laboratory of Cal Tech, and a few others. And to round out our requirements, you remember, we wanted also the proven capabilities of Von Braun's group at Huntsville.

Last month the President announced his intention to transfer the Huntsville space and missile specialists from the Army to NASA.

By law this measure must go to the Congress for consideration there. But already the business is well underway of working out the numerous details of such a transfer of thousands of people and of great facilities.

We are delighted by this development and we believe that the Huntsville scientists under Dr. Von Braun are very pleased at the outcome.

As to plans and programs, we had first to complete the space projects that were transferred to NASA from ARPA and the military services. These were the pioneer space probes, the Explorer satellites, and the remaining Vanguards. The experiments we will fly in the next eighteen months will have to be flown by the vehicles available to us, modified to secure some slight improvement, but still under-powered for the work we want to do.

As you know we have laid on a vehicle program which will give us increasing levels of thrust in the Vega and Centaur vehicles. These systems, based on the use of the Atlas as the first stage booster, will be the first space vehicles designed to make optimum use of the total thrust of the Atlas. Both should be available early in 1961, although I must caution that reliability is bound to be relatively low in the first few flights.

The first real break-through in propulsion thrust level in the base booster stage will come only with the introduction of the Saturn vehicle. Management and funding responsibilities for this project will be transferred to NASA.

As a matter of fact, the management responsibility now is in NASA, although the funding for the balance of this fiscal year will continue with ARPA. It seems clear that the rate of spending on Saturn will be increased substantially for 1961 and for the following fiscal years.

The Huntsville group will take over technical management responsibility for the million and a half pounds single-chamber engine development now under way at Rocketdyne. Thus we will have in this one group the total job of managing the very large booster program in the U. S. space effort.

But until these new vehicles are ready we must do the very best we can and the most that we can with what we have. This we are doing. We have in the Atlas rocket the necessary thrust to put a man into a low orbit around the earth. This is the goal of the project Mercury, which carries our highest priority. I wish I could guarantee that we will beat the Russians to this accomplishment. I can't, of course, except to say that if hard work is going to do this job, we will succeed.

Without minimizing the fact that we very much wish we had bigger rocket engine systems today I can say that we are making very good use of what we have to explore the space immediately around the earth. In the past two years the U. S. has launched thirteen scientific earth satellites, and three deep space probes.

Through the miracles of microminiaturization we have used our small payload possibilities to obtain amazingly large and valuable amounts of new information. The fact remains, we need and must acquire the capability of sending heavier payloads into space. The best little man was never quite as good as the best big man.

In the years ahead as our new space vehicles are pressed into use, we plan a comprehensive series of lunar missions and interplanetary and planetary experiments. As soon thereafter as we can we will undertake manned-exploration of space, the moon, the planets of our solar system. I don't suggest any dates. I simply repeat, as soon thereafter as we can.

And now a word about financing our national space program. In fiscal 1959 we had a total of $335 million. For fiscal 1960 we asked for $530 million. This was really made up of $45 million as a supplemental to the 1959, and $485 million in the 1960 regular budget, a total of $530 million, saying that this was a lean budget, the minimum amount -- minimum amount -- necessary to do what we needed to do. The Congress cut us $30 million, and this has hurt.

Progress has been slowed. It was inevitable it would be.

I am not at liberty to say what the request for fiscal 1961 will be. This figure, as an important segment of the President's budget, must remain undisclosed until Mr. Eisenhower sends his recommendation to the Congress in January. But this much I can say: We will be asking for substantially more money, not counting the necessary financing of the Huntsville team and the Saturn project.

To summarize, in less than fourteen months we have brought together the basic elements of what I think to be a strong organization. With the research centers inherited from NACA we have a broadly based in-house research and development operation active in both the aeronautics and space fields.

On the space flight side of the operation we can now look forward to similar strength in-house, buttressed by the important talents of industry under our contracting program. You may remember that almost 70 per cent of our budget is to be made through this contracting route, principally with industry.

As to the division of effort in the space flight area, we expect to center at Huntsville the bulk of our work in the design and development of space vehicle systems. At JPL on the West Coast -- the Jet Propulsion Laboratory -- we will concentrate on lunar and interplanetary programs. While at Goddard

Space Flight Center, out here at Beltsville, now under process of construction, we will concentrate the bulk of the responsibility for earth satellite programs and for project Mercury.

Starting from scratch one can say that much has been accomplished in fourteen months, but one must agree that we have only started. Every day I think our objectives become more clear. We are no more satisfied than you are with the progress that we are making. The only difference between our positions in these matters is that we have the responsibility for doing something about this dissatisfaction.

To paraphrase a line that was prominently displayed in many offices during the past war, "The difficult we are doing, the impossible takes just a little longer."

I have faith that we will win in this contest. If I didn't have that faith I wouldn't continue in this job. And that, gentlemen, puts me solidly in the line for your questions. Thank you very much for listening.

(Applause.)

QUESTION: And now we turn to the question period, spontaneous, unrehearsed. While I know all the answers to the questions you have sent up in the last hour, I have for the last month or so carefully refrained from supplying them to our speaker.

As your editor in selecting questions this year I have tried to avoid "when did you start beating your wife" questions. But this is a professional club, and I start today with this one: Why haven't you held regular press conferences, and when will you start?

DR. GLENNAN: I haven't held regular press conferences. As a matter of fact, Bill, I don't think I have held any. I have presided at one or two where we were discussing the results of some of our activities. I have introduced the astronauts to members of the fraternity, and I have even introduced the monkeys.

The highlight of my experience in Washington was to start off a press conference with a couple of monkeys. I don't know when I will start holding regular press conferences. But you may be certain of one thing: That when I do, I will have something to say.

QUESTION: I will follow this up with one more professional question, and then we will turn to science.

In view of the fact that the work NASA does at Wallops Island is not classified, why is the place closed to the press?

DR. GLENNAN: We are trying to do an excellent job in research and development, and part of the condition under which research and development best can be done is the climate that will most encourage the people who are involved in the research and development.

We have therefore tried to make of that installation, which as you say is unclassified, a place where our engineers and scientists can, without being placed under the pressures of time schedules and previous announcements of events that take place, do the kind of good science that they ought to be doing. I can say just this much to you, Bill: The day that we fail to tell you that we have had a failure there, we will change that policy.

QUESTION: Can you tell us what new hard scientific information regarding the hidden side of the moon was established by the photograph officially released by the Soviet Government?

DR. GLENNAN: I am not enough of a scientist to give you any real insight into this. I suspect the best that can be said about it is that it is the first picture of the other side of the moon. Scientists seem to be satisfied that they at least have seen the other side of the moon.

QUESTION: What specific sources of technical data are used to conclude that the Soviet lunar probes are what the Russians claim they are?

DR. GLENNAN: With respect to the picture of the moon, I think it must be very clear that at some point we are going to take a picture of the other side of the moon, and it would be a very, very embarrassing moment for the Russians if our picture revealed that they really had jazzed up that picture which they have published. I think in these areas of science there are too many good people all over the world who are active in the same areas for the Soviet scientists to take a chance on attempting to kid the rest of the world.

With respect to the probes themselves, as they are going out toward the moon or outer space, they have given information on tracking, the tracking situation to Lovell, at

Jodrell Bank, in England. Using that information he has been able to pick up the probe on its way out, listen to it. He has satisfied himself, as he has satisfied any other scientist, I think, that actually the probes that the Russians say they sent out actually did go out. Indeed, in some of our own stations we have been able to track I think at least one of these probes on its way out toward the moon.

QUESTION: I guess the last sentence of that partially answers the next question, but let me ask it anyway.

Can you explain the fact that Jodrell Bank was the only Free World tracking station that succeeded in detecting the Russian Lunik.

(Tape recording reel No. 2.)

DR. GLENNAN: -- in which they sent their probes, so that they could read out themselves, because they have limited tracking stations, we think, limited to their own territory. The English tracking station is sufficiently in sight of the probes as they go out from the Soviet Union that they can do the tracking while our stations, the probe does not get in electronic sight of our stations.

QUESTION: An Iron Curtain diplomat told me a joke the other day -- at least he said it was a joke. He said that an optimist is one whose children are learning Russian, and a pessimist is one whose children are learning Chinese.

We know a lot about the training program that the astronauts are getting, but are they learning Russian so that they can talk to the man on the moon?

DR. GLENNAN: Not to my knowledge, and I don't expect that they will have any problem in talking Russian to the man on the moon.

QUESTION: Do you see any hope at all for a joint program with the Russians for the exploration of space?

DR. GLENNAN: I not only see hope, but I have a very great interest in this particular aspect of our work.

I suspect I have said this to some of you before. I have found in my short life that I didn't stay very long with any job into which I couldn't put myself body and soul. When

I came down here to the Atomic Energy Commission I didn't know very much about the atom. But I soon became very much convinced that this was the real deterrent to a hot war, and so I could stick with that one and work at it very hard.

In this situation, when I came down here a little over a year ago, I was in much the same position. I didn't know very much about this space business. But I soon came to believe, as I now believe and hold very tightly to, the thought that science is today an international language, perhaps the international language. Space is kind of an all-pervasive place. We can't do this job by ourselves as well as we can do it with the help of others. Indeed we have the help of a great many others around the world.

And therefore it seems to me that this activity probably presents the best chance of developing a new kind of cooperative activity throughout the world, and we should not write off the Soviets in this. Indeed, yesterday at our own instance some of our people, Dr. Dryden, Dr. Homer Newell, Mr. Frutkin, who is head of our Office of International Programs, met with Sedov and the other Russians and just talked as scientists do back and forth about their experiences, and talked casually, to be sure, about the desirability of interchange of information, of interchange of scientists, perhaps interchange of instrumentation, all of this looking to the ultimate development of a cooperative project.

I wouldn't say a total program, but a cooperative project at least, with the Russians. Science is international. We don't have a corner on it. We can learn from them, they can learn from us. And I think this is an area, the space business, where we ought to make serious attempts to find the way to develop that kind of cooperation with the scientists of Russia.

QUESTION: Referring back, Dr. Glennan, to your opening remarks, did you accept that $100 check, and if so, how did you apply it?

Going somewhat beyond the $100 figure, is NASA going to ask Congress for supplemental appropriations for fiscal 1960?

DR. GLENNAN: With respect to the $100 check, you really have me. We were about to accept it, but it is not clear -- I am not sure -- Mr. Johnson is here. Did we ever get that solved? May we accept the check or do we have to send it back or what?

We have been thinking about it for three months. This is normal process in Washington.

Are we going to ask for a supplemental? I can only say that it is under discussion at the present time.

QUESTION: Is or was last Monday?

DR. GLENNAN: Draw your own conclusions.

QUESTION: There are two questions that kind of go together, Dr. Glennan. The first one is domestic: Is there any truth in the story that Thurston Morton has asked you to help in putting his elephant back into orbit next year. In other words, do domestic and international politics play any role in the timing of your space shots?

The corollary question, it seems to me, is how do you explain the Russian capability of performing almost unbelievable scientific feats in perfect coordination with the most important political events, such as the Mikoyan and Khrushchev visits to the United States?

DR. GLENNAN: I would say to you in answer to the first question that we do not plan any of our shots with respect to any forthcoming political events. As a matter of fact, I have great hope that the space business will not become a political football in the next campaign. This is serious business. It should be out of politics.

I just hope that we can do our work without being made the butt or the middle man here in the sort of line of fire that might well appear in a political campaign.

How do the Russians do this? I don't know. I haven't been there. Not to their launching sites at least. But I would hazard this guess for you: So far as we are able to determine, they are using a rocket which they have fired over and over again, and only in this way with one of these complicated beasts will you get anything in the way of reliability.

So that they probably have fired that rocket as many times, that particular type of rocket, as many times as we have fired all the variety of rockets that we are playing with.

They can, therefore, schedule a shot with much more chance of getting it off at the time that they schedule it, than we. You will recall that the Vice President did suggest from a platform that they had had three failures before Mr.

Khrushchev's shot came off. He seemed to admit something of that kind by saying simply that they had the second one standing by and just interchange them.

So they must have some problems of this sort. But by and large I think that the reliability that they have in their rockets permits this kind of scheduling.

QUESTION: Again, two related questions.

If Dr. von Braun is now so pleased at his transfer, why did he seem so unhappy when the same transfer was proposed months ago?

The second question: What are you going to do with this team when you get them?

DR. GLENNAN: First, he was working in the first instance for the Army.

In the second instance, "what are we going to do with them?" I tried to answer that in my remarks. We expect fully to concentrate at Huntsville. I will say the bulk, because I don't want to say just every nut and bolt. But the bulk of our work in the space vehicle field, the development of the space vehicles which will take to outer space the satellites and probes that we want to send there. Those vehicles will be developed and the launching operations will be managed, controlled, by von Braun's group.

I do want to emphasize that this exercise of preparing for the transfer is going exceedingly well at the present time. I couldn't ask for a greater spirit of cooperation on the part of von Braun himself, his people, and of the Army. This is somewhat different than a year ago when I wasn't saying very much, but the Army was. They had worked for that group a year ago and were able to make it stand up as a necessity for the defense of the nation. Our project, I think, must take second place to anything which the Defense Department really requires in supporting activities and events of the nation.

QUESTION: Dr. Glennan, on more than one occasion you admitted that we are in a space race and that we can't afford to finish second. Dr. Pickering made a talk about this yesterday at the Jet Propulsion Laboratory, but he had an added idea that it might help us if the President would also admit that we are in a race, because he hasn't so admitted. Do you agree with Dr. Pickering?

DR. GLENNAN: That is a provocative question.

QUESTION: Yes, it is; and it was meant to be.

What financial investment do you estimate that the Russians are making in their space program, and how does this compare with our own investment?

DR. GLENNAN: I have no real basis for judging that. When I was over there, and I guess it is the same today, the ruble was ten to the dollar for the tourist like myself; four to the dollar, presumably, for the Soviet citizen. I was told that there was some sort of a market in Switzerland where it was 16 or 18 to the dollar. So you have to pay your money and take your choice as to the kind of investment that they are making.

I would suspect that they probably are investing a greater percentage of their gross national product, which in their case is their total budget, than we are.

QUESTION: This is a technical question that I have to accept on faith. So if I seem more stupid than usual, it is just because I am reading the question.

Will Able stage replacement delay the moon shot? And second, will it delay project Tiros from which it was borrowed?

DR. GLENNAN: In the first place, it wasn't borrowed from project Tiros that I know of. And I haven't any idea whether it will delay the moon shot at all. I don't see that there is any reason for it to do so.

QUESTION: I am sure glad I got in that disclaimer in advance.

(Laughter.)

DR. GLENNAN: Maybe I should ask if you know when the moon shot is scheduled?

QUESTION: No, I don't. Do you?

As an educator, what is your opinion of the loyalty oath required today for a student to receive a student's loan to further his education?

DR. GLENNAN: As an educator, I am against it. Not that I don't believe that any of us ought to balk at taking a loyalty oath, but I certainly don't think that there is any reason to take a loyalty oath to get a loan to continue one's college education. This seems to me to be tying two things together that just make no sense at all.

My instution, in Cleveland, is accepting these moneys with the statement that they expect fully that the government will remove this restrictive clause in the Act.

I can say no more than that. I just don't think it is right.

QUESTION: There are reports that a large rocket will be fired for NASA at Cape Canaveral soon. Can you tell us the date and objectives for this firing?

DR. GLENNAN: This is another provocative question. I think that the fraternity recognizes the manner in which we have attempted to play this game with them, giving information in advance of our shots at the Cape. I really can not answer this outside of those policies.

QUESTION: This one refers back also to your opening remarks. Perhaps it will give you a chance to expand on them. How do you account for the alleged lack of interest that the American people are more interested in the cranberry rhubarb and related problems than they are in space problems?

DR. GLENNAN: That was the question that I thought maybe some of you would have an answer to for me.

I think that there is something more fundamental than just lack of interest in space. There is a lack of understanding in this country, a lack of appreciation of the importance of scientific research and development. This is a nation which has grown great through the application of the findings of science. We wouldn't be where we are today were it not for this situation.

Indeed, I think that the Russians have accepted this as a fact of life. If they are going to compete in a world that is based on science and technology, they are darn well going to have to have scientists and technologists, and that is what gave them the fillip in their educational system, the determination to go ahead and build great strength in these fields.

I think that the American public -- and for this I accept my share of the blame as an educator, and I think we need perhaps some of us in the fraternity, or some of you in the fraternity to help a great deal in this regard -- the importance of strength in scientific research can not, in my opinion, be over-stressed in the kind of a world in which we presently live. This extends into the space area simply because the activities in space today are largely those of scientific research.

I think it may be gratuitous for me to say, but basically all of us have gotten to the point in life where we have our chin a little bit more than over the curbstone. We are eating well, we have the good things of life, and why worry about some of these things that don't impinge upon our consciousness, except once in a while in the newspapers?

Sustained support of a program like this is absolutely necessary. You can't do research with this kind of a support curve. I would rather have a lower continuous level of support and interest than to have great peaks and valleys. You get no place with that kind of thing in pursuing your ends in scientific research and development.

QUESTION: Dr. Glennan, I want to thank you for coming here today. I want to present to you this certificate of appreciation awarded in recognition of meritorious service to correspondents, press, radio and television in the Nation's Capital.

And with it a final question, which in itself requires something of a preface. There is a rule around here that a current president and past president may not win any important door prize. From that I move to the final question.

In the interests of freedom of the press, can not we have one reporter on the first astronaut flight, on a pool basis, if need be?

DR. GLENNAN: Do you want a place in the capsule, Bill?

QUESTION: No. No.

Gentlemen, that concludes our luncheon. Thank you very much.

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